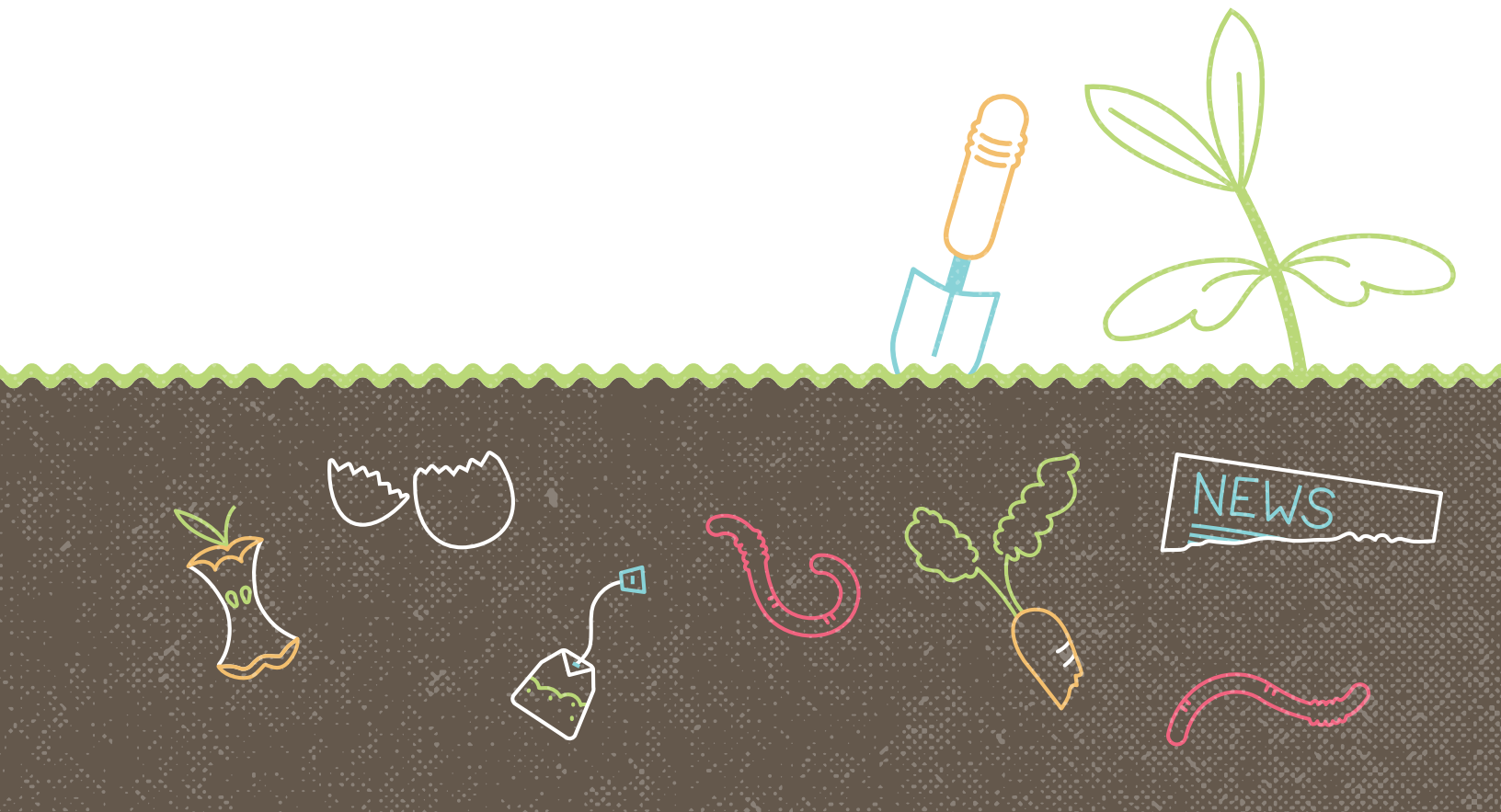


HAROLD S. VINCENT HIGH SCHOOL

# Composting Manual



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## **Introduction to the Harold S. Vincent High School Composting Manual**

*The purpose of this manual is to provide Harold S. Vincent High School (VHS) teachers and students with composting options that may be a good fit for their site. Classroom composting options will also be provided and will likely be the easiest and most feasible method for VHS to implement. Other larger scale composting options will require more planning and coordination to ensure that VHS will have enough waste input, labor power, and dedicated management to sustain an operation. These larger scale options will also be included in the manual along with their requirements for scaling up and sustaining these operations.*

*The manual is organized in three parts outlining compost basics, methods, and preparation, and includes appendices as a handy reference.*

## Part I: Compost Basics

Based on an assessment of VHS's current capacity, resources, and potential access to resources this manual will be proposing six composting alternatives for VHS. Two of the methods are classroom based, while the others are larger scale operations that could be located on VHS's property. Before making our recommendations, however, let's explore what composting is, how it benefits a school and its students, and some of the composting basics that will be essential to maintaining an on-site operation.

## Benefits of composting at VHS?

Composting is the natural process of turning various organic materials into a substance called humus through controlled biological decomposition. The process usually occurs within a compost pile or bin that is managed to optimize the conditions for decomposing microbes to thrive; this is done by providing air and moisture and achieving sufficient temperatures to ensure weed seeds, invasive pests, and pathogens are destroyed. The end product is a dark brown, crumbly, dirt-like substance generally known as compost. Compost is an excellent nutrient-rich soil amendment that can also be used as a fertilizer or mulch. One of the most valuable aspects of composting is that it keeps many common garbage items (e.g. food scraps) out of the landfill. Here are some specific benefits of composting at VHS.

## What are the benefits for Composting at VHS?

☒ **It's good for the environment**

- Composting organic waste keeps it out of the school's waste stream and subsequently, the landfills.

☒ **Waste is instead turned into a soil enhancement that can be returned to the earth as a means to grow food and other plant life**

☒ **It creates valuable and practical resources**

- Compost is useful for gardening, landscaping, or house plants.
- Composting provides a rich topic for scientific investigation and discovery in the classroom.

☒ **It has the potential to save the school money**

- Food waste is a large proportion of the waste that ends up in the schools dumpster, diverting this waste from the schools waste streams and into a useable product can be very cost effective if done right.

☒ **It gives students the opportunity for ownership over a project**

- Students can manage the compost piles and be responsible for the success of their product (compost).
- Students can create a useable product that can potentially be marketed and sold to the community.
- It gives students an opportunity to be creative in marketing and branding their product.

☒ **Larger composting operations have the potential to engage the surrounding community**

- Gives community members an opportunity to engage with students by donating their own food waste to the compost operation and/or purchasing the finished compost from students.

☒ **VHS is making strides towards restarting its agricultural program**

- Composting is a means to tie the schools existing infrastructure to this goal – compost utilizes the high school's land and requires that the staff and engineers, students, and faculty all work together to support the operation.
- It provides the school with free fertilizer for cultivation of the soil for anything the students will grow.
- Composting on school grounds sends a message that VHS is not only dedicated to environmental sustainability, but that it is also dedicated to the sustainability of the futures of each of its students.

# Compost Basics

*The following information is sourced from the Compost Basics [Fact Sheet] from [recyclingconnections.org](http://recyclingconnections.org).*

## Speed Up Nature — Compost!

Your compost pile is a living system. And microbes are the work horses of your pile. Keep the bacteria and fungi happy and they will work to make compost faster for you. It's all about managing your pile.

### WHAT TO MICROBES NEED? SAME AS US.

- Food..... Carbon + Nitrogen
- Water..... Damp as a wrung out sponge
- Oxygen ..... Turn the pile regularly to fluff up all channels
- Temperature..... Best above 50°F outside

### WHAT DO YOU NEED TO COMPOST?

1. Buy or make a bin — commercial or home built
2. Feed the microbes:
  - Handfuls of brown or carbon (dried plant material, it shredded paper, etc.)
  - 1 handful of green or nitrogen (green plant material, food scraps or other nitrogen)
3. Layer 2 ft browns then 1 ft greens. Top layer is always brown to manage odors and hold in moisture
4. Water as build pile
5. Turn once every week or two to add oxygen
6. Cure 4 weeks, once appears like dark and crumbly, to mature the compost

**Hot Pile:** Build all at once as a batch. Microbes multiply; The pile heats up to 132–140°F. Turn weekly so each part of pile gets hot and kills weed seeds and most diseases.

**Cool Pile:** Build as you get materials. Top layer should always be browns. Turn when you can. Don't add weed seeds or diseased plants.

Stockpile some fall leaves so they are available in summer to combine with nitrogen in summer when carbon sources are harder to find. Place the bin near house, garden and within hose reach. Sun or shade is ok.

### HOW SOON CAN I GET FINISHED COMPOST?

- Fast, Hot method: 2–6 months if you keep the microbes happy
- Slow, Cool method: 1–2 years

#### Finished compost is:

- Dark brown, crumbly — leaves, grass, food scraps are unrecognizable
- Smells earthy like a greenhouse
- Doesn't reheat

## COMPOST USES

- Add to soil..... Dig into top 4–5 inches of soil
- Use as mulch ..... 2–3 inches to top of soil around flowers, vegetables, trees and shrubs
- Mix in potting soil ..... See recipes next page
- Lawn top dressing ..... Screen with ½ inch hardware cloth attached to wooden frame
- Compost tea ..... Soak bag of compost in water and add oxygen with a flash aerator to increase microbial populations — spray on lawns, garden and houseplant

## BENEFITS

- Improves soil and plant health
- Reduces fertilizer and pesticide needs
- Reduces water needs
- Slows erosion
- Saves money

## YES — Compost These

\* = Green (Nitrogen)    ♣ = Brown (Carbon)

- Grass clippings \* ♣
- Leaves \* ♣
- Weeds/garden debris \* ♣
- Small brush, twigs ♣
- Wood ash (small amounts) **adds potash**
- Sawdust/wood chips (small amounts) ♣
- Egg shells **adds calcium**
- Coffee grounds \*
- Hay ♣
- Manure from herbivores (plant eaters) \*
- Paper, cardboard ♣
- Fur, hair, natural fibers and feathers \*
- Food scraps (only if buried in pile) \*

## NO — Don't compost these

- Meat, bones, fat
- Dairy products
- Oils (cooking and salad)
- Whole branches, logs
- Pet or human waste
- Charcoal briquette ash
- Sawdust from treated wood
- Diseased plants (unless hot composted)
- Persistent weeds (quack grass)
- Thorny branches

## Troubleshooting

Too dry	Crackles too much	Add water. Keep the pile damp as wrung out sponge.
Too wet	Soggy, may smell (gone anerobic)	Turn to add oxygen. Hold off watering till pile dries out some.
All green	Pile mats, smells bad	Turn pile and add brown.
Meat, fat, salad oils	Pile mats, smells attracts varmints	Remove meat, fat of materials with oil.

## POTTING SOIL RECIPES

- Recipe #1: 2 parts garden loam + 1 part fine, sharp sand + 1 part finished mature compost
- Recipe #2: 2 parts soil-less mix + 1 part finished, mature compost
- Recipe #3: 1 part peat + 1 part perlite + 1 part compost



# On-site Versus Off-site Composting

## On-site Composting

When the collection and the composting of the school's food scraps and other organic waste takes place on school grounds it is referred to as on-site composting. All the composting methods recommended in this manual are on-site operations.

## Off-site Composting

When the school's food scraps and other organic waste is collected but not composted on-site but at some other location it is called off-site composting. In this scenario, the school would hire a waste hauler to pick up their food waste and transport it to their facility to be composted. The waste hauler keeps the compost produced.

*Please note, before any Milwaukee Public School (MPS) can hire a waste hauler to pick up their food scraps they must first follow MPS purchasing and bidding requirements.*

For more information see Administrative Policies of the Milwaukee Public Schools: Administrative Policy 3.09: [http://mps.milwaukee.k12.wi.us/MPS-English/OBG/Clerk-Services/MPS-Rules-and-Policies/Chapter03/Administrative\\_Policy\\_03\\_09.pdf](http://mps.milwaukee.k12.wi.us/MPS-English/OBG/Clerk-Services/MPS-Rules-and-Policies/Chapter03/Administrative_Policy_03_09.pdf).

# Milwaukee Public Schools Facilities and Maintenance Requirements

Prior to starting any on-site composting operation recommended in this manual, MPS requires approval from its Facilities and Maintenance department. Per the MPS website:

"In accordance with Milwaukee Board of School Directors (MBSD) Policy 3.09, all proposed maintenance, new construction, and remodeling projects must be submitted to the Department of Facilities and Maintenance."

For more information on proper procedure for new projects and for contact information for MPS Facilities and Maintenance personnel see Facilities and Maintenance Services on the MPS website:

<http://mps.milwaukee.k12.wi.us/en/District/About-MPS/Departments/Office-of-Operations/Facilities--Maintenance-Services.htm>.

## When DNR Rules and Regulations Apply

The composting recommendations made in this manual are generally smaller scale. However, if in the future the school decides to scale up its operation to commercial sized piles (i.e. including organic waste from sources outside of and in addition to the organic waste collected from the school's lunch room facilities) then they should consult the Wisconsin's Department of Natural Resource's rules and regulations on composting.

Compost facilities are a type of solid waste processing facility regulated under s. NR 502.12 Wis. Adm. Code. The DNR regulates large on-site municipal and private compost operations that compost more than 50 cubic yards of source-separated compostable material or more than 20,000 cubic yards of yard residuals. Anyone composting at this scale will be required to submit a Plan of Operation Checklist for Compost Facilities to the DNR, this form can be found on the Wisconsin's DNR website at <http://dnr.wi.gov/files/PDF/pubs/wa/wa1586.pdf>.

For more information on exemption from the DNR composting requirements of NR 502.12 see <http://dnr.wi.gov/files/PDF/pubs/wa/wa1025.pdf>.

For more information on all composting rules and regulations see the Wisconsin DNR website at <http://dnr.wi.gov/topic/recycling/regs.html>.

All composting recommendations made in this manual will have to follow basic operating and location requirements for any on-site composting operation including the following: preventing composting from becoming a nuisance or a health hazard to neighboring property owners and ensuring nutrients/contaminants from compost are not released to groundwater or nearby lakes and streams. Rules also require most compost sites to turn piles or windrows and to measure their temperature. In addition, the compost site must be properly maintained and kept free of pests (Wisconsin DNR, 2015).

# Assessing Goals and Resources

To determine which composting method(s) to incorporate at VHS, faculty and staff should first assess three key areas:

1. What are the school's **goals** with regard to composting?
2. What **resources** are already available? What resources need to be obtained?
3. What are the existing **challenges** to building and sustaining the operation that must be overcome?

## Goals

The following goals should be assessed to help identify what VHS faculty and staff wish to achieve and which composting method(s) can help them to reach these goals:

**Waste diversion:** diverting organic waste from school dumpsters keeps it out of landfills and supports sustainable practices

**Usable product for on-site use or for public sale:** compost used for garden beds, for experimental gardens, for a campus farm, or for sale to the local community

**Cost savings:** potential for reduction in disposal costs for the school with a larger scale operation

**Curriculum/education:** compost methods that can be incorporated into the classroom and/or supports education, particularly, Science, Technology, Engineering and Mathematics (STEM) curriculum

**Revenue:** potential for profit to be made from sale of compost from larger scale operations and/or the products grown with that compost

## Resources

Depending on the size and location of the operation, there are a number of physical resources that will need to be made available.

*These include the following:*

**Tractor:** to turn large piles; transport organic waste, carbon sources, finished product

**Student/volunteer labor:** to turn piles, add waste and browns/greens, take temperatures, do soil tests/experiments, move bins, and coordinate tasks

**Available carbon source:** paper or wood (browns) for compost

**2+ acres:** for larger, on-site operations only

**Classroom component:** space for smaller operations and for compost curriculum

**Dedicated manager/compost monitor:** a person (or team) who can manage the piles on a daily basis and make sure all aspects of kitchen and cafeteria food sorting are implemented properly

**Community support:** approval from the community for large scale operations on-site and potentially support a large scale operation by adding their own waste to the operation

**Source separation in cafeteria:** compostable food scraps and materials are properly sorted by students, staff, and faculty

**Source separation in kitchen:** compostable food scraps and materials are properly sorted by kitchen staff

**Strong recycling program:** high rates of recycling and proper disposal of recyclable materials by students, faculty, and staff correlate to a higher probability of a successful composting program

**Storage space near dumpsters/dock:** recommended if hiring a waste hauler to pick-up food scraps for off-site composting

**3' x 3' space in the classroom:** recommended for vermicomposting



# Health and Safety

## WAIVERS

Anyone who works or volunteers for activities involving compost must sign a Milwaukee Public Schools legal department-approved waiver.

*The following is an excerpt from the UWM Hoop House Manual 2014:*

## FIRE

Fires are extremely rare when compost piles are well maintained, but spontaneous combustion can occur if conditions are just right.

## INCLEMENT WEATHER

Check local weather broadcasts and the National Weather Service ([www.weather.gov](http://www.weather.gov)) to determine if the weather will make conditions unsafe for compost maintenance. If the pick-up or maintenance must be postponed, inform the necessary stakeholders and schedule a new time for the pick-up/maintenance.

## AIR QUALITY

As with any activity, there is the potential to inhale airborne particles. This is especially true when turning a compost pile. It is recommended that everyone wear air-filtering masks while turning piles (Harrison, 2007) and that people with compromised immune systems, asthma, or other health issues consult a physician before beginning work.

*Aspergillus fumigatus*, a ubiquitous fungus that is both a normal and integral part of the composting process, can pose a potential health risk to certain high-risk individuals. *Aspergillus fumigatus* is one of the most common fungi in the world (Bünger, J., et al, 2007) and is most commonly found in decomposing material, like leaves, as well as in healthy soils. "While most people do not experience any reaction to compost bins or compost, we need to minimize the risks so that we can protect susceptible people" (Brown, 2005).

When inhaled, the immune system normally acts as if the *A. fumigatus* spores were an innocent visitor, unless it invades tissues. In that event, the immune system responds to the spores like it would to a pathogenic bacteria or virus, and acts to protect the body, ultimately attacking and expelling the spores (Ault and Schott, 1994). If inhaled, in large doses, by people with compromised immune systems, asthma, or other respiratory issues, *A. fumigatus* can be harmful. Risks can be reduced by speaking with your physician before working in the HH, campus gardens, or outside. Wearing appropriate protective gear, such as facemasks, can further reduce risks.

The possibility of reducing potential health impacts by following good practices is recognized (Millner, et al., 1994). For composting operations at the VHS campus, the following recommendations (Harrison, 2007) apply:

- Maintain good air-flow through the compost
- Minimize handling
- Turn compost based on temperatures, not a schedule

## PART I: Compost Basics

- Minimize disturbance of dusty areas by equipment
- Minimize dust by adding moisture to the piles and to trafficked areas
- Water dry materials and feedstocks to minimize the creation of dust

### LIFTING

Proper lifting technique is important and can prevent injuries. See link below for best methods.

[osha.gov/SLTC/etools/electricalcontractors/materials/heavy.html](https://osha.gov/SLTC/etools/electricalcontractors/materials/heavy.html)

### PROTECTIVE CLOTHING

It is recommended that all faculty, students, and volunteers involved in the compost process go through Blood Pathogen Training, follow MPS protocols, and use appropriate protection whenever handling waste. Appropriate protection includes cut-resistant and abrasion-resistant gloves, facemasks, and eye protection. These articles should also be worn when piles are turned, when using construction tools, and whenever there is a risk of cuts, abrasions, or airborne particles that could be inhaled or cause damage to the eyes.

Remove gloves by pulling off each hand while still gloved. This enables the gloves to be removed without the surface of the skin coming into contact with the outside of the glove.

It is highly recommended that workers and volunteers involved in the compost process wear steel-toed rubber boots and clothing appropriate for the weather. Dressing in layers, wearing sunscreen, and staying hydrated are all recommended practices.

### POWERTOOLS

It is important to be properly trained and comfortable using power tools before operation. More information can be found at <https://www.osha.gov/Publications/osh3080.html>. If you have questions or concerns, it is important to ask a supervisor before attempting operation of power tools.

### SNOW AND ICE

The best way to avoid slipping and falling on the ice is to wear appropriate shoes, pay attention as you walk, and stay on established, plowed paths. Compost operations can be especially treacherous during the winter, because the heat from the piles can cause snow to melt, which can pose dangers, especially if the water freezes into ice.

### COMMON SENSE

- Wash your hands after working with food waste or compost.
- Do not consume diverted food waste.
- Know what you are doing before taking action.
- If you have questions, or are unsure about any procedures, ask your supervisor or contact MPS Department of School Safety and Security.

## Part II: Recommended Compost Methods

After a 2015 assessment of the grounds at VHS and the campus' potential capacity, the following five on-site compost methods are recommended for consideration:

### Classroom composting

#### 1) VERMICOMPOSTING

Vermicomposting is the process in which worms, usually red wigglers, white worms or other compost specific earthworms consume a heterogeneous mixture of decomposing vegetable or food waste, and bedding materials to produce worm castings/vermicast (worm manure). Vermicomposting often requires less space than more traditional forms of composting and can be done indoors with the right set-up.



### On-site composting

#### 1) 3-BIN COMPOST SYSTEM

A 3-bin compost system allows you easily contain and expedite the natural process that takes place to produce compost from organic waste. The system also has the added benefits of reducing the weight of the compost that needs to be turned, allows you to add fresh waste to the system without disturbing the compost that is already breaking down or curing, and allows you to store the finished compost until you are ready to use it. A 3-bin system can also be used throughout the year.



#### 2) EARTHTUB™

Similar to a larger in-vessel composting system, the mid-sized compost system is an enclosed system used to achieve maximum control of temperature, oxygen and moisture. Compost can be turned via a crank located on the lid. Compost can also be cured within the system. The Earth Tub is designed to operate outdoors and makes it easy to compost year round in colder climates.



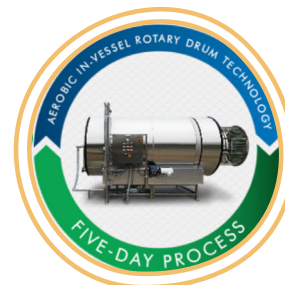
#### 3) MULTI-PILE HOOP HOUSE COMPOSTING

Multiple compost piles are managed inside a hoop house where they can be efficiently maintained and controlled. A hoop house has the ability to capture the heat generated from the compost making it easier to maintain piles in the winter months and extending the growing season for plants grown in the hoop house.



#### 4) IN-VESSEL COMPOSTING

Composting that is done inside a building, container, or vessel where composting materials are confined and air flow and temperature can be controlled. In-vessel composters have the ability to produce larger quantities of compost and require less manpower and management to maintain and produce compost than manually or mechanically turned compost piles. They also have the benefit of being enclosed systems that have the potential to minimize odors.



## PART II: Recommended Compost Methods

While all five compost methods recommended in this manual are well-suited for implementation at VHS, some options require more capacity and/or different resources than others. **Table 1** can help guide the decision making process by matching goals and necessary resources to the recommended composting methods.

	In-vessel	Hoop House	Earth Tub	3-Bin System	Vermicompost
<b>What is the goal of the composting program?</b>					
Waste diversion — environmental	x	x	x		
Usable product for use on-site	x	x	x	x	x
Usable product for sale to community	x	x	x	x	x
Cost savings	x	x	x		
Curriculum/Education	x	x	x	x	x
Revenue	x	x	x		
<b>Does this facility possess the necessary resources?</b>					
Tractor					
Student/volunteer labor	x	x	x	x	x
Available carbon source (paper,wood)	x	x	x	x	x
2+ acres					
Classroom component					x
Dedicated manager	x	x	x		
Compost monitor		x		x	x
Community support	x	x	x		
Source separation in cafeteria	x	x	x		
Source separation in kitchen	x	x	x		
Strong recycling program	x	x	x		
Storage space near dumpsters/dock					
3'x3' space in the classroom					x

Table 1

Use the **Compost Capacity Checklist** we've started for VHS (see page 35 in the Appendix for the template) as a starting point for assessing capacity for implementing a specific program now or in the future.

### Compost Capacity Checklist for Composting

What is the goal of this program?	What resources are available?	What challenges must be overcome?
<input type="checkbox"/> Diversion <input type="checkbox"/> Usable product for on-site use <input type="checkbox"/> Usable product for sale <input type="checkbox"/> Cost savings <input type="checkbox"/> Revenue	<input type="checkbox"/> Tractors <input type="checkbox"/> Hoop house <input type="checkbox"/> Student labors <input type="checkbox"/> Walk-in cooler for storage of source separated organic waste <input type="checkbox"/> Educators <input type="checkbox"/> Carbon (from wood chips and lunchroom waste) <input type="checkbox"/> Community support <input type="checkbox"/> Containers/bins <input type="checkbox"/> Dedicated manager	<input type="checkbox"/> Logistics <input type="checkbox"/> Attitudes and behaviors <input type="checkbox"/> Institution of an effective recycling program <input type="checkbox"/> Communication <input type="checkbox"/> Regulations <input type="checkbox"/> Waste audit/accurate data collection <input type="checkbox"/> Effective signage <input type="checkbox"/> Compost testing <input type="checkbox"/> Water source for on-site operation <input type="checkbox"/> System of coordination and accountability <input type="checkbox"/> Underlying soil/contaminants

**Table 2** further outlines inputs of time, labor, space, product outputs and uses, and other requirements for each of the five composting methods recommended. The table also includes "Levels of Engagement" or the estimated number of potential students and faculty that could participate in curriculum designed around composting and maintenance of the operation. The table also identifies when there is a need to engage the surrounding community's support via donations of their own organic waste to the larger operations that require a lot of organic waste.

## PART II: Recommended Compost Methods

	In-vessel Mechanical System	Multi-pile Hoop House	Earth Tub	3-Bin System	Vermicompost
<b>Inputs and Outputs</b>					
Time commitment (per week)	20 hours	15–20 hours	2–5 hours	5–10 hours	< 2hours
Amount of food waste necessary for operation (lbs/week)	10,000 lbs	3,000 lbs	200–1,000 lbs	500 lbs	< 5 lbs
Time it takes to produce finished product (compost/vermicompost)	One week, 80% of input	2 months	2–4 weeks	2–3 months	Variable (3 weeks–2 months)
Dedicated manager?	Yes	Yes	Potentially	No	No
Approximate investment	\$200, 000+	\$5,000+	\$10,000	\$500	< \$20
Space Commitment	1,000 sq ft enclosed	800 sq ft outdoor	50 sq ft indoor/ outdoor	200 sq ft outdoor	4 sq ft indoor
Ability/Need for Community Drop-off Site	Yes	Yes	No	No	No
Sellable Product? (compost/vermicompost)	Yes, in high volume, rapidly	Yes	No	No	Yes, in small amounts
Finished product uses	For campus farm, for sale to the public	For an experimental campus garden (kitchen, supplement, farm stand sales...)	For a few garden raised beds	For a few garden raised beds	For a few potted plants
<b>Participation of faculty/staff, students, community</b>					
Number of persons necessary for labor (per week)	4 ( one manager + volunteers)	10 (one manager + volunteers)	1–3	1–3	1–3
Level of engagement	60+ students, 3+ teachers, outside expert community, neighborhood community, business community	60+ students, 3+ teachers, outside expert community, neighborhood community	20–60 students, 1–3+ teachers, outside expert community	20–60 students, 1–3+ teachers, outside expert community	20–60 students, 1–3 teachers
Potential number of Vincent courses integrated	3+	3+	1–3	1–3	1–3
<b>Requirements</b>					
Requires outside regulation (DNR)	Yes	Yes	No	No	No
Requires testing of compost	Yes	Yes	No	No	No
Requires community support/ approval	Potentially	Yes	No	No	No

Table 2

## Instructions for Recommended Methods

This section will outline how to implement each of the five proposed methods for composting at VHS, starting from the smallest scale operation: vermicomposting, the 3-Bin system, multi-pile hoop house composting, the Earth Tub, and in-vessel composting.

The method that would be the easiest to implement and requires the least amount of planning and inputs including food waste, time, and monetary investment, is vermicomposting. Vermicomposting methods can be easily incorporated into the classroom setting and are supported by existing curriculum (see page 50 in the Appendix for resources).

The other proposed composting methods are all outdoor, on-site methods that will require moderate to substantial planning, investment, and coordination to implement. Part II of the manual will focus on planning for and maintaining these types of operations.

# Compost Method 1: Indoor Vermicomposting

## Vermicomposting

Vermicomposting is the process in which worms, usually red wigglers, white worms or other compost specific earthworms use a heterogeneous mixture of decomposing vegetable or food waste, and bedding materials to produce worm castings/vermicast (worm manure). Vermicomposting often requires less space than more traditional forms of composting and can be done indoors with the right set-up.



*Image credit:  
Allan Henderson,  
flickr.com/allanhenderson*

## Setting Up Your Worm Box

- When starting a worm bin, you will need to determine the right size bin for your needs. Decide how much food waste you want to process and where you plan to store the bin.
- If bins are kept outside they should be in a place where it's not too hot or too cold. Temperatures between 55°F and 77°F will be the most productive for your worms.

### TOOLS, EQUIPMENT, AND COST

- (2) Containers for your worms (18 gallon totes: Menards/Home Depot each cost \$5.00–\$20.00)
- Supply of biodegradable bedding (newspaper, leaves, and soil)
- Supply of worms: UNCOVERED Industries, Inc. — Red worms: 500 worms @ \$31.50, 1000 worms @ \$46.95, Can -O- Worms @ \$139.50 (all orders include shipping)
- Supply of food waste/organic material: fruits and vegetables, trimmings, grains, beans, bread (without butter, margarine, mayonnaise, or sauce on it), eggs shells, fallen leaves, tea bags, coffee grounds and filters and lawn clippings/weeds can all be added
- Plan for harvesting the vermicompost, where to store it and what it will be used for



*Image credit:  
grow-it-organically.com*

### INGREDIENTS:

- Dry Bedding Material (use a combination of one or more dry bedding ingredients listed below)
- Brown leaves/straw
- Shredded paper or newsprint (avoid glossy paper)
- Egg cartons/ coffee trays
- Crushed eggshells or agricultural lime
- One liter of soil (ordinary garden soil)

### STEPS TO PREPARE BEDDING

## PART II: Recommended Compost Methods

1. Fill worm bin with dry bedding materials (leaves, shredded paper, etc.)
2. Add water (approximately 2–3 liters) and mix contents; bedding should be consistency of a wet sponge
3. Pour off any excess water (worm bin should be 1/2 full of wet material)
4. Add more dry bedding or water as required
5. Add crushed eggshells/limestone and soil
6. Add worms to the bins (note: to ensure your worm bin is fully ventilated, drill at least 10–20 3/16" holes in the bin)
7. Water should be left out overnight prior to preparing bedding (this will ensure any chlorine evaporates and will bring water to room temperature)
8. Do not use water that has been through a water softener — the salt will burn your worms
9. Important: be sure to add the worms to the compost under direct light
10. Simply place the worms on top of bedding. Their natural photophobic tendencies will force the worms into the bedding to a darker, more comfortable environment. Allow the worms to settle into bedding overnight
11. Start feeding with organic compostable materials the next day

## Day to Day Procedures

As the worms do not like to be disturbed, it is best to feed the worms one to two times a week rather than daily. Worms eat about half their weight daily. If feeding twice a week, add 1.5 to 2 lbs. each time. If a lot of food scraps are left over from previous feeding wait a day or two prior to adding additional food.

- Bury food a couple of inches under the bedding
- Bury the food in different locations each time
- Be sure to cover food with bedding, fruit flies are attracted to exposed foods. Fruit flies can also be reduced by adding shredded newspaper to the bin
- Sprinkle a handful or so of crushed egg shells on top of bedding about once a week. Egg shells counter the acidity in food scraps
- Do not overfeed the worms
- Absorb excess moisture if bedding becomes too wet with more dry bedding material
- Worms generate heat and produce liquid, therefore, condensation will form on the lid
- If you smell ammonia, your soil is likely waterlogged and does not have enough oxygen (anaerobic decomposition). Drain the bin and add dry bedding
- Keep track of feeding schedule by placing a laminated copy of the days fed, food types added, and other notes near the bin. You can also write the date of feeding in a journal for record keeping.

*For an alternative method of vermicomposting see Garden Tower Vermicomposting on pages 36–37 in the Appendix.*

## Harvesting

When the contents of your bin are looking more like soil than shredded newspaper, you have compost! Since it is not necessary to harvest right away, you can plan a harvesting time to fit your schedule. The amount of time you need depends on the harvesting method you choose.

### CONE METHOD

- Find a work area, preferably outside in a shady area, during a period of moderate temperature and lay down a tarp or large piece of plastic
- Carefully empty the contents of the bin, worms and all, onto the work surface
- Separate the piles into cones about 6 inches in diameter
- Give the worms 10 minutes to bury down away from the light
- After they have done so, sift through the compost from each pile a handful of times until all you have left is a pile of worms
- The harvesting compost can be transferred to a separate storage container and the worms can return to their newly prepared home

### MIGRATING

This is a handy method for those who want to harvest quickly:

- Open your bin and gently push the compost over to one side
- Prepare new bedding and place it in the now empty half of the bin
- From this point on, stop placing food in the compost side of the bin, and begin feeding in the new bedding area
- Once most of your worms have made the journey over to their new bedding area, you can remove the compost
- At this point you, would want to add more bedding to fill in the empty area of the bin. You can alternate your harvesting side on a continuous basis

### SCOOP METHOD

Perfect method for a small amount of compost at a time:

- Open your bin to allow light to penetrate casting, thus gently forcing the worms to burrow away
- Stirring the surface a bit will also encourage the worms to dive
- After about 10 minutes, scoop off the top layer of casting
- There should be few, if any worms in the compost you have removed
- If you still need more compost, continue to leave the lid off for another 10 minutes to begin scooping again

## Compost Method 2: Outdoor 3-Bin Composting System

A 3-bin compost system allows you easily contain and expedite the natural process that takes place to produce compost from organic waste. The system also has the added benefits of reducing the weight of the compost that needs to be turned, allows you to add fresh waste to the system without disturbing the compost that is already breaking down or curing, and allows you to store the finished compost until you are ready to use it. A 3-bin system can also be used throughout the year.



### Setting Up a (3-Bin) Compost System

- Secure the materials and people you will need to construct your compost bin. A composting system should be large enough to handle the demands of your school's food scraps. It should, therefore, be larger than a home composting bin.
- 3-Bin systems cost anywhere from \$30–\$400 to construct depending on if you used salvaged materials (e.g. construction pallets) or new materials to construct (for construction ideas and instructions see page 50 in the Appendix for online resources).
- Find a local source to provide your school with brown material (wood chips, hay or leaves), things you will need to help your food scraps turn into compost.
- Designate a class to be the Compost Keepers. They should empty the food scraps daily, monitor the piles and take measurements.
- Designate a staff member to check on the compost pile, add amendments (browns/greens/water), turn over piles regularly and add to the garden when needed.

\*For more detailed instructions on compost pile care see pages 38–47 in the Appendix on Compost Pile Care and Troubleshooting for Piles in 3-Bin System and Hoop House.



*Image credit:  
mylittleveggiegarden.  
wordpress.com*

### EQUIPMENT AND SUPPLIES

All of the parts of the composting process needs to be in place before you can start collecting food scraps during the school day. Make sure to secure the materials you need to compost at school, you will need:

- 5 Gallon buckets with lids— start with at least 5, the amount needed will be determined by the number of students, their eating habits and frequency of your pick up. A waste audit can be conducted to determine how much food scrap waste the school generates each week.
- Scale that measures in one pound increments. Needed to record the weight of food scraps composted in a period of time. It also can show savings in disposal of solid waste produced by the cafeteria.
- Cloth rags — have a supply of rags on hand to be used for cleanup of food scraps from buckets and floors.
- Work gloves
- One rolling cart for housing buckets - to transport buckets from the cafeteria to outside.
- Shovel, pitchfork or garden fork for turning compost piles.
- A steady supply of bulking materials — wood chips, leaves, and hay.
- Clip board with record sheets for recording daily temperature
- Compost thermometer — used to monitor the daily temperature of the compost pile. This will help staff and students follow the progress of decomposition. Temperatures can rise to 150°F, but if temperatures fall and the food scraps have not decomposed, adjustments need to be made.
- Sifting screen (hardware chicken wire over wooden frame) — this is used to sift through piles to find insects or to see how much food has decomposed. Pieces of non-decomposed food or large scraps can be shifted from your final product.

### How the 3-Bin System Works

*Bin #1)* All new organic waste is thrown and layered with browns and greens in the first bin. Turn the waste inside this bin frequently and keep it moist. There may be many a lot bugs in the first bin but that's OK. If everything is in balance and properly covered, the compost pile should not smell.

*Bin #2)* As the waste in bin number one reaches the top, prepare to move it to bin number two. In moving all of the contents of bin number one to bin number two, decomposing matter will be thoroughly mixed up and aerated. After the contents are moved, bin one will be empty and can be restarted with new material. Never add new material to bin number two. The only job bin number two has is to continue to compost and break down.

*Bin #3)* As bin number one is full again, it's time to move bin one to bin two, bin two to bin three, and so on. By the time bin number one is full for the third time, bin number three should be fully composted and ready to use in the garden. Remember, new material is ONLY added to the first compost bin.

The easiest way to know if your compost in bin number three is absolutely done is by sight and feel. If you can still discern large chunks of food and/or specific plants, it needs more time. If it is hot or warm to the touch, then it is still decomposing. Don't use it if it isn't finished, it could burn and/or kill plants.

## Day to Day Procedures

1. Place a sign above compost buckets that show students what to compost. Some food service use a small white board to write what can be composted each day.
2. Students scrape ALL food scraps into 5 gallon buckets that sit on a cart in the lunchroom.
3. Weigh food scraps by placing a bucket on a scale and subtracting the weight of the container. Record the amount to show savings in disposal of solid waste produced by the cafeteria. The weights can also be used to construct math problems or track the composting operation.
4. A designated staff or group of students (one grade can be the compost keepers) to take the buckets to the compost bins outside.
5. Take the compost temperature by placing the long probe into the center of the compost pile. Record the reading and all other data (see data sheets on pages 48–49 in the Appendix). If the temperature has dropped, decomposition has taken place or the balance of the compost needs to be adjusted.
6. Spread the food scraps onto pile, do not pile them high.

## On-going Procedures

A lot of the decomposition takes place in a compost pile. In fact, food wastes and bulking materials are reduced as much as two thirds! To get the most out of your compost, you will need to:

### CHECK AND MAINTAIN BIN

- Any structural problems should be reported to supervising adult so they can be fixed right away.

### TURN COMPOST PILE

- When there is a drop in temperature or the pile is overflowing out of the bin, it is time to turn your pile. Simply, this means to mix it up or move it from one bin to another.
- The best way to turn your pile is use a garden fork or pick fork to move the materials in one to another bin. The “green” materials and “brown” materials will be mixed up and this will give compost organisms the opportunity to break down more food scraps.

### TEST AND CURE FINISHED COMPOST

- To begin the curing process, stop adding food scraps to the pile (the curing process happens in the third bin). Turn the pile over once a week or every other week and keep moist.
- When the large particles have broken down and the temperature has cooled, it will be ready to use as compost.
- Placing partially decompose compost on plants will burn new shoots due to an unstable nitrogen and salt content. To prevent this, be sure to “cure” the compost before adding it to a garden.
- A successful compost will be dark, crumbly and sweet smelling. The process should take about a year.
- Use the finished compost as a soil amendment by mixing into garden soil before planting or by putting into soil around plants.

## Compost Method 3: The Earth Tub™

*Image credit: compostingtechnologies.com*

Similar to the larger in-vessel composting system, the mid-sized compost system is an enclosed system used to achieve maximum control of temperature, oxygen and moisture. Compost can be turned via a crank located on the lid. Compost can also be cured within the system. The Earth Tub is designed to operate outdoors and makes it easy to compost year round in colder climates. It's recommended that the Earth Tub is installed in a shaded or covered location to prevent long-term exposure to solar radiation and provide dry operating conditions in rain and snow.

### COST

Earth Tub™ Package — \$9,975.00 (USD), Green Mountain Technologies

*The following is an excerpt from the Youth Energy Summit Earth Tub overview:*

### Earth Tub overview

The Earth Tub is designed specifically for on-site composting of food-wastes. The Earth Tub is a fully enclosed composting vessel featuring power mixing, compost aeration, and biofiltration of all process air. This self-contained unit is ideal for composting at schools, universities, restaurants, hospitals and supermarkets.

### KEY FEATURES

- Easy to operate
- Rapid process reduces compost volume quickly
- Heavy-duty plastic construction
- Minimal need for bulking agent
- Short time required for mixing/loading
- Temperature controlled system
- Insulated for cold weather operation
- Thorough compost mixing

### QUICK FACTS

- Cold weather: the Earth Tub has been installed in some very cold locations. It may need supplemental heat if the temperature remains below 10°F for more than 7 days. The aeration system should be shut down during cold weather.
- The Earth Tub is capable of processing as little as 40 lb per day or as much as 500 lb per day



*Image credit:  
mylittleveggiegarden.  
wordpress.com*

## Using the Earth Tub

### LOADING

- Organic materials are loaded through the large hatchway in the cover.

### INGREDIENTS

- Periodically, dry materials such as wood chips, shredded paper or shavings can be added to insure that porosity and moisture levels are ideal for composting. NOTE: The Earth Tub is designed to process kitchen-prep waste and plate scrapings.
- Meats, cheese, and other fatty foods should be kept below 10% of the total waste.

### MIXING

- The auger motor must be run and the cover rotated to properly mix the organic material inside the Tub.
- Two revolutions of the rotating cover are required to mix the outside and center of the Earth Tub. The auger will shred and mix a ton or more of compost in 10–15 minutes. NOTE: A complete mix should take approximately 10 minutes, and should be performed at least two times per week.
- Active compost and odor control
- Maintaining aerobic conditions and controlling temperature are essential for composting and odor control.
- The aeration system draws air through the compost and forces the exhaust air through a biofiltration air purification system to remove odors.
- Liquids are collected and disposed to a sanitary sewer or holding tank.
- Once the Earth Tub reached capacity, no more additional food waste should be added for ~14 days once the Earth Tub has been filled.

### COMPOST COLLECTION

- Heat generated in the Earth Tub rapidly breaks down the food scraps. The volume reduction is typically 70% or higher.
- After 3–4 weeks of active composting, open the discharge doors and the auger pushes the compost out as it rotates past the discharge door.

NOTE: further information on collection and preparing end-use compost is available on the Green Mountain Technologies Commercial Composting Solutions website: [compostingtechnology.com/in-vessel-systems/earth-tub](http://compostingtechnology.com/in-vessel-systems/earth-tub)

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*Frederick, R. (2014). UWM  
Hoop House Manual.  
Unpublished Manuscript, Office  
of Sustainability, University  
of Wisconsin-Milwaukee,  
Milwaukee.*

## Composting Method 4: Multi-pile Hoop House Composting

Multiple compost piles are managed inside a hoop house where they can be efficiently maintained and controlled. A hoop house has the ability to capture the heat generated from the compost making it easier to maintain piles in the winter months and extending the growing season for plants grown in the hoop house.

Hoop houses, also known as high tunnels, cost anywhere from \$90 – \$9,000 depending on the size and construction. VHS currently has a high tunnel in its possession that is not in use and could be a great resource as a structure to both grow plants and compost within.

*The following is an excerpt from the UWM Hoop House Manual 2014 prepared by Renee Frederick:*

### Why Compost in a Hoop House (HH)

The process of composting generates heat, which can be used to heat buildings. The heat in the HH can be used to extend the growing season of plants, while creating a valuable end product. Will Allen, at his urban farm, Growing Power, based in Milwaukee, WI, pioneered the modern model of composting in hoop houses.

### PROCEDURES

This manual outlines how to keep the HH running, though not every procedure occurs every day. Here is a rough timeline for the duties involved. These procedures are only for compost production. Growing produce will add many more tasks to this list.

- Three times per week:
- Take and record pile temperatures
- Monitor piles for moisture and changes in temperature [see pages 48-49 in the Appendix for data sheets]
- Pick up diverted waste and deliver to HH
  - Method for pick-up currently includes one staff member and one volunteer and two wheelbarrows
  - Diverted food waste is collected in 5-gallon buckets and left on the dock
  - Add material to piles, record inputs for each pile

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*Frederick, R. (2014). UWM Hoop House Manual. Unpublished Manuscript, Office of Sustainability, University of Wisconsin-Milwaukee, Milwaukee.*



### WEEKLY TASKS:

- Turn piles as necessary
- Add water to pile as necessary
  - See section on Pile Moisture for more information (page 40 in the Appendix)
  - Enter hand-recorded data from HH to the data sheets in computer
  - Look for trends in pile temperatures
  - Plan necessary turns for the next week
  - Coordinate volunteer schedules
  - Create schedules for volunteers, including what duties they should plan on performing (office work where they need to bring a laptop, versus turning piles, where they should dress in layers and bring plenty of water to drink). Email these schedules on Friday afternoons.



### MONTHLY TASKS:

- Test finished compost
  - Consult the TMECC manual [available online at [compostingcouncil.org/tmecc](http://compostingcouncil.org/tmecc)] and record the method of testing done.
- Move finished compost to storage space
  - Finished compost should be stored where it is unlikely to become contaminated with fresh weed seeds. This is best accomplished with tarps above and below the pile.

\*For more detailed instructions on compost pile care and data sheet templates see ages 38–49 in the Appendix.



### BUILDING FRAMES TO SEPARATE MULTIPLE PILES WITHIN THE HOOP HOUSE

In the Hoop House, constructing backless frames, supported by 9" of woodchips on either side, is the best method. The frames allow for piles of sufficient size to be built, while ensuring easy access and pile turning. This style of composting is known as a 'turned pile'. The frames are temporary if they need to be moved, but sturdy enough to be reused. The 1' of woodchips protects the sides of the hoop house structure, and provides extra insulation for the pile.

New frames should be 1' away from the hoop house walls. This 1' of space should be filled with wood chips to provide insulation and protect the hoop house walls from hot material. The frames should be made from pallets, as they are free, generally well-constructed. The pallets should be spaced ~7'–8' apart, with wood chips anchoring and surrounding the pallets on both sides. The wood chips should run the depth of the pallet, be at least 2' high and 9' wide.

It may be necessary to add additional wood chips if the pallets are unsteady or the wooden frame of the Hoop House is exposed. The heat and moisture from the compost pile can damage wood (both the pallets and the frame of the Hoop House), so it is important to protect the frame from the actual pile with wood chips or a tarp. The pallets are less in need of protection, but it is easier to protect the pallets than it is to replace them.

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*Frederick, R. (2014). UWM Hoop House Manual. Unpublished Manuscript, Office of Sustainability, University of Wisconsin-Milwaukee, Milwaukee.*

## PART II: Recommended Compost Methods

Well-constructed piles should have proper shape and size, pile inoculants, and covering. Also necessary are good C:N ratios (see C:N Ratios), sufficient space for air, water, and microbes to travel (see Carbon Sources), and sufficient moisture (see Moisture). All items referenced in this paragraph can be found in the Appendix on pages 38–47.

### PILE SHAPE

The pile should resemble an inverted V if viewed in profile. This is the most efficient shape for both windrows and turned piles. The heat travels through the pile and leaves the pile through a ‘chimney’ at the top. Inverted V shape piles are easy to make (use a shovel) and easy to maintain.

### PILE SIZE

The size of the pile is an important factor for heat generation and timely break down of material. Piles must be at least 1 cu yd in size, though larger piles are preferable (Alexander, 2007). 1 cu yd of material provides enough insulation for internal temperatures to reach 160°F. It is important to note that as food waste breakdowns, it loses much of its structure, causing the pile size to shrink. In order to maintain temperatures, new material must be added until the pile can maintain a size of at least 1 cu yd. If the frame is constructed as described above, the pile should measure at least 6’ x 4’ x 4’. Piles over 6’ high can result in anaerobic conditions, as the weight of the pile will compress the lower, middle portion.

### PILE INOCULANTS

When creating a new bin, material should be thoroughly layered to encourage even breakdown. Fresh material such as food waste and woodchips are generally low in microbial activity, making decomposition slow. Adding decomposing material to the fresh material can speed breakdown and increase the diversity of microbes in the finished product. The decomposing materials are known as ‘inoculants’ or ‘compost starters’. There is no need to purchase a compost starter, as any already decomposing material will work. Examples include: partially finished compost, moldy straw or hay, used woodchips from the screening of mature compost, or moldy produce.

### PILE INPUTS (AKA FEEDSTOCKS)

The diverted waste that becomes compost is known as feedstocks, or alternately, inputs, while the finished compost is known as outputs. There are many types of composting systems, each with specific ranges for acceptable inputs. The HH uses a manually turned pile style of composting, housed within a HH, located in an urban area, which limits suitable material for composting. A general rule of thumb for what can be composted in the pile is “Anything that comes from the earth, with minimal processing.” To start, the HH should only accept pre-consumer kitchen waste, farm waste (but not animal waste), yard waste, and coffee grounds. As the operation expands, experiments on the effects of using postconsumer feedstocks on finished compost quality should be conducted.

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Milwaukee.*



### HOOP HOUSE MAINTENANCE

The Hoop House requires basic maintenance, like any structure. This can include caulking corners, replacing parts of the plastic, and snow removal. Hoop Houses are generally considered to be low maintenance, as there are few moving parts, and, if well-constructed, typically last ~10 years before needing plastic replacements.

### PESTS

Pests are any part of the natural world humans would prefer not to have around. These can include bugs, molds, and other threats to plant health, as well as deer, rabbits, and rodents. A comprehensive plan for managing pests is still being developed.

Options for management of threats to plants include companion planting and biological controls. Options for management of rodents and other pests could include physical barriers, traps and biological controls.

### DOOR LOCKS

A major concern on any campus is the threat of vandalism. The HH should remain locked when not in use.

### VENTILATION

The HH is equipped with post-installation roll-up sides. These are useful in the summer for increasing air circulation and controlling temperatures. During the winter, it is recommended that the sides remain down and additional Polygal sides are added. For ventilation during the winter, open the doors.

### SNOW REMOVAL

The HH is not designed to hold the weight of snow. It is important to remove snow as soon as it appears. This is best accomplished by tapping a blunt tool or broom against the interior plastic ceiling, being very careful to not puncture the plastic. A long handled broom can be very effective.

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## Composting Method 5: In-vessel Composting

In-vessel composting is done in a large and enclosed mechanized system that allows mass quantities of food and other organic materials to be processed and turned into compost in a relatively short time period. The enclosed container is built to control and easily monitor temperature, moisture, and aeration. This large scale system should be considered if the goal is to produce large quantities of compost for sale and/or soil amendment use on campus, divert large quantities of waste from landfills, and reduce hauling costs with minimal labor and monitoring.

### RECOMMENDED: THE FOR SOLUTIONS MODEL 1000



*Image credit: FOR Solutions, LLC*

The FOR Solutions Model 1000 is an aerobic in-vessel rotary drum that has the capability large quantities of food scraps and organic waste and turning it into compost in five days. According to the For Solutions website, their system can compost items not typically acceptable for compost; the For Solutions Model readily accepts most organic materials, including meats, produce, bones, and dairy. It can also take in napkins, paper towels, and compostable plates, bowls, cutlery, and paper cups. The system uses shredded cardboard, straw and hay, wood chips and wood pellets as carbon sources and bulking agents. The five-day composting process produces high-quality, nutrient-dense compost that is immediately ready to use. The system is odorless and energy efficient and will not attract pests or rodents.

Before investing in this model, VHS would need to substantially scale up their waste collection to approximately 10,000 lbs. /week. This could potentially happen if VHS became a drop-off site for organic waste from the surrounding communities and/or other MPS schools. Substantial planning and coordination would be required prior to investing in an in-vessel composting system. Systems like the For Solutions Model 1000 cost ~\$200,000–\$300,000. Despite the large initial investment, these systems have demonstrated a measurable Return on Investment (ROI).

[forsolutionsllc.com/in-vessel-composting-system](http://forsolutionsllc.com/in-vessel-composting-system)

## Part III:

# Preparing for and Building a Compost Operation

*The following information is an excerpt from Green Mountain Farm to School: A Guide to Starting a Composting Program in Your School and can be used as a template for building a compost program at VHS.*

## Annual Timeline

### LAUNCH YEAR TIMELINE

- Form a Steering Committee
- Draft a plan
- Secure materials and supplies
- Train kitchen staff: develop daily routine, food handling procedures, and container placement
- Have an all-school assembly as an event kick-off for recycling/compost program
- Offer a small group training for staff, students, and volunteers on cafeteria procedures to ensure a smooth transition
- Have an in-class training with ALL classes about how they will compost during the school day
- Train one of the older grades as Compost Keepers by holding an in-class workshop that will teach them about monitoring and caring for the compost throughout the year.
- Send a note home to parents describing the composting that is going on at school and the role their children have in it. This is a great way to build enthusiasm and create a connection to home.
- Start composting – On the first day of composting, make an announcement during lunch. Have the Compost Keepers stand by the trash cans and compost buckets to remind students where food and trash goes.
- Use community volunteers to monitor cafeteria food waste recycling system for approximately 2 weeks.
- Thank you cards — be sure to properly thank everyone that helped start, cared for, or provided materials for the compost.

### SECOND YEAR AND BEYOND TIMELINE

- Train the next class of Compost Keepers. Hold an in-class workshop that will teach them about monitoring and caring for the compost throughout the year.
- On the first day of composting, have All-School Refresher Training. Make an announcement during lunch to remind students how to use the compost bins. Have the Compost Keepers stand by the trash cans and compost buckets to remind students where food and trash goes. For the next few days, closely watch the students sorting and train when necessary.

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*Green Mountain Farm to School. (2010). A Guide to Starting a Compost Program in Your School. Retrieved from: <http://www.greenmountainfarmtoschool.org/wp/wp-content/uploads/Guide-to-Starting-a-School-Compost-Program.pdf>*

- Send a note home to parents describing the composting that is going on at school and the role their children have in it. This is a great way to build enthusiasm and create a connection to home.
- Thank you cards — Be sure to properly thank everyone that helped start, cared for, or provided materials for the compost.
- Program report: Evaluate the effectiveness of your composting infrastructure. Keep track and share the volume of compost collected, the students who helped and the community members involved. Use your program report to challenge your school to make a bigger impact next year.
- Adjust your trash pick-up schedule accordingly to reflect the diversion of food scraps and recycling, monitor cost change

## Roles and Responsibilities

In order to have a successful compost program, the responsibilities need to be clearly defined and designated. The staff that works with the food the most, Food Service Directors, will inevitably have the largest role, but they should not be alone. Don't be afraid to get the students involved or throw a work party and invite parents for the largest tasks.

**Coordinator:** This person will be in charge of making sure all of the tasks are assigned and completed. A coordinator is the go-to person for any questions or contacts.

**Designated manager/Compost Monitor:** Will set up and maintain the compost process in the kitchen, design signage, maintain bins and assure there is appropriate time to sort wastes between lunch periods. The Compost Monitor has a crucial role of reminding other assigned adults and students when they are to volunteer as the Lunch Sorter.

**Lunch Sorter:** This can be one person or a rotating group that watches the emptying of trays at lunch to ensure that food scraps, recyclables and garbage go into the correct bins.

**Compost Keeper Class:** One class in the school should be in charge of the compost. After lunch, two students will take the food scrap bins to the compost pile. They will take the compost's temperature, record it, add the food scraps, and top it off with woodchips. If the temperature drops, damage to the compost bin system, or anything unusual, they will report it to their teacher or the coordinator.

**Bin Mover:** At least once a year, the resting compost bin needs to be emptied to make room for the new school year's food scraps. If the compost is fully decomposed it can be added to the garden. If it is not, it can be added to an already existing compost pile.

**Pile Monitor:** The compost needs to be monitored on a regular basis by taking the temperature and layering with hay. This can be done by a class on a daily basis.

**Materials and Resource Coordinator:** Materials like hay, manure or even tubs and lumber, need to be acquired. A person needs to be assigned the task of finding free, donated, or cheap sources of materials. They should also make sure those supplies are at the school when they are needed.

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*Green Mountain Farm to School. (2010). A Guide to Starting a Compost Program in Your School. Retrieved from: <http://www.greenmountainfarmtoschool.org/wp/wp-content/uploads/Guide-to-Starting-a-School-Compost-Program.pdf>*



# Staff and Community Connections

## TEACHERS

- Art teachers can use their classes to help with signage for composting
- Science teachers can use the compost for exploration or build on the topic by starting a worm bin in their classroom
- All teachers should encourage students to compost fully, set a proper example at lunch, and be knowledgeable about composting if students have questions.

## STUDENTS

- Students or classes can have leadership roles.
- Students can plan and be responsible for extra projects that improve the composting system.
- Start a recycling/composting club during the school day or after school.

## CUSTODIAL STAFF [AND ENGINEERS]

- Can help determine where an appropriate place for composting on site would be to maintain curb appeal and functionality.

## FOOD SERVICE STAFF

- Kitchen managers can compost their kitchen food waste and encourage students to eat good food and compost their food scraps.
- Help decide where the best place for compost bucket in kitchen and the location of outside bin placement.
- They can also write the food that is compostable daily on a white board sign to make it easier for students.
- Remember to also work with school nutrition services supervisor if you plan to involve kitchen staff in the composting operation.

## PARENTS

- Can help by volunteering and being a great resource for materials, talent and time when starting up a program.

# Evaluation

The steering committee should meet regularly to evaluate the composting program and operation. A short summary describing the successes and food scraps diverted from the landfill may justify the continuation of the program

- Is the daily processing of food scraps running smoothly?
- Are the bins and equipment in good repair?
- Are the students and staff volunteers working well?
- What is the general attitude of the students and staff about the composting program?
- What adjustments can be made to make the process more efficient?
- How can we recognize and celebrate our accomplishments thus far?

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*Green Mountain Farm to School. (2010). A Guide to Starting a Compost Program in Your School. Retrieved from: <http://www.greenmountainfarmtoschool.org/wp/wp-content/uploads/Guide-to-Starting-a-School-Compost-Program.pdf>*



# APPENDICES





# Compost Capacity Checklist for VHS

What is the goal of this program?	What resources are available?	What challenges must be overcome?
<input type="checkbox"/> Diversion <input type="checkbox"/> Usable product for on-site use <input type="checkbox"/> Usable product for sale <input type="checkbox"/> Cost savings <input type="checkbox"/> Revenue	<input type="checkbox"/> Tractors <input type="checkbox"/> Hoop house <input type="checkbox"/> Student labors <input type="checkbox"/> Walk-in cooler for storage of source separated organic waste <input type="checkbox"/> Educators <input type="checkbox"/> Carbon (from wood chips and lunchroom waste) <input type="checkbox"/> Community support <input type="checkbox"/> Containers/bins <input type="checkbox"/> Dedicated manager	<input type="checkbox"/> Logistics <input type="checkbox"/> Attitudes and behaviors <input type="checkbox"/> Institution of an effective recycling program <input type="checkbox"/> Communication <input type="checkbox"/> Regulations <input type="checkbox"/> Waste audit/accurate data collection <input type="checkbox"/> Effective signage <input type="checkbox"/> Compost testing <input type="checkbox"/> Water source for on-site operation <input type="checkbox"/> System of coordination and accountability <input type="checkbox"/> Underlying soil/contaminants

# Garden Tower Vermicomposting



Image credit: *gardentowerproject.com*

The garden tower essentially is a vertical garden and vermicomposter all in one. The tower has the capacity to grow over 50 plants. The tower has an inner tube/core where food scraps can be added for composting. Garden towers can be purchased online starting at \$360 or they can be built by hand for around \$100.

## TOOLS, EQUIPMENT, AND COST

- Supply of biodegradable bedding (newspaper, leaves, soil)
- Supply of worms: UNCOVERED Industries, Inc. — Red worms: 500 worms: \$31.50, 1000 worms: \$46.95, Can -O- Worms: \$139.50 (all orders include shipping)
- Supply of food waste (fruits and vegetables, trimmings, grains, beans, breads (without butter, margarine or mayonnaise), eggs shells, fallen leaves, tea bags, coffee grounds and filters and lawn clippings and weeds)
- Plan for harvesting the vermicompost

## INGREDIENTS:

- 6–7 cubic feet of soil
- One cup of red wigglers
- Egg cartons/ coffee trays
- Crushed eggshells or agricultural lime
- Compostable food scraps
- Dry bedding material (use a combination of one or more dry bedding ingredients listed below)
  - Brown leaves/straw
  - Shredded paper or newsprint (avoid glossy paper)
  - Coconut coir

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**SETTING UP YOUR GROWTOWER**

- Add a soil mixture (6–7 cubic feet) that is organic if possible. Very light and lofty mixes are available that will do a great job while only adding 20–30 pounds of weight (dry).
- Remove a handful of soil from the pocket to be planted (when planting starts).
- Straighten bound plant roots and insert starter plant into pocket. Replace removed handful of soil and use it to support the new plant. Lightly press soil around the plant stem to bolster root zone and prevent soil loss during watering.
- Gently water each pocket 1–2 times daily for 7 days or until plants develop new roots and appear stable.
- Adding some mulch, leaf litter (decomposing leaves), coir (from the coconut husk), or other fibrous material to the top surface will help reduce evaporation and prevent soil disturbance making watering even easier.
- Add 2 or more pounds of compostable food scraps to the compost tube prior to adding worms.
- Add 2 to 6 ounces or about one cup of healthy worms. Red wigglers work to maximize productivity and nutrient cycling in the garden tower. At least one cup (two ounces) of worms should be added at least one week after you have a several inches of kitchen scraps in the “compost tube.” Composting worms eat organic substances that are already decomposing (not fresh greens). A single garden tower can easily support a full pound of red wigglers, but it is not necessary to start out with that many worms.

**ONCE GARDEN TOWER IS ESTABLISHED, FOLLOW THESE INSTRUCTIONS FOR CONTINUED CARE:**

- Add equal parts acceptable food waste and shredded newspaper weekly (about 4 cups each).
- Remember to water only the top of the garden tower once the plants are established.
- When gardeners water, they are not watering the plants, but rather the soil, so each plant does not need separate watering in each pocket.
- Keep a wash bin underneath the tower to collect the water drainage. This can be dumped back into the garden tower.
- Try not to “stuff” the compost tube to avoid compaction beyond what occurs naturally as the worms quickly minimize your kitchen scraps.
- For best results, add “bedding or bulking” materials along with kitchen scraps at a 1:2 ratio (1 part bedding: 2 parts kitchen scraps). This helps maintain compost airflow and drainage and prevents an excessive rate of decomposition by adjusting the nutrient balance. Popular bedding materials include torn/shredded cardboard, shredded paper, coconut coir, peat moss, and even handfuls of potting soil.

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# Compost Pile Care and Troubleshooting for Piles in 3-bin System and Hoop House

*The following is taken directly from the UWM Hoop House Manual 2014 prepared by Renee Frederick:*

## NITROGEN (AKA GREENS)

Nitrogen sources, also known as “greens,” are materials that are generally wet, colorful, and unprocessed. Coffee grounds and used tea bags are also considered N sources, even though they are brown in color.

### Common sources of Nitrogen for HH composting:

- Fruit waste
- Vegetable waste
- Coffee grounds
- Spent teabags
- Lawn and garden waste (pesticide free)
- Fresh leaves

## CARBON (AKA BROWNS)

Carbon sources, also known as “browns,” are materials generally brown in color, and are often tree byproducts.

### Sources available for HH composting can include:

- Wood chips
- Sawdust
- Straw
- Dried, dead leaves
- Hay
- Shredded newspaper
- Eggshells
- Coconut coir

Note: the inputs used will affect the pH of the pile, in addition to its C:N ratio, both of which can affect the time needed to break down the materials and the end uses of the finished compost. Citrus fruits, pine needles and coffee grounds often have a low pH, which can alter the pH of the pile, and have a detrimental effect on produce grown in the finished compost.

Note: The best carbon sources are straw and sawdust. Other materials (leaves, hay, newspaper) can form mats within the pile, slowing the flow of air and microbes, possibly causing to anaerobic conditions. Wood chips take a very long time to break down and will affect the particle size of the finished compost, making extra screening necessary. Coconut coir is a good carbon source, but costs money, whereas the other choices do not.

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## C:N RATIOS

The carbon to nitrogen ratio (C:N) is an indication of nitrogen availability for the process of biological degradation. The C:N ratio is the ratio of total organic carbon to total nitrogen. Total organic carbon is the carbon fraction of organic matter (or biodegradable volatile solids). Total nitrogen includes organic nitrogen plus inorganic nitrogen. The inorganic nitrogen fraction is dominated by ammonia nitrogen  $\text{NH}_4^+-\text{N}$  and nitrate nitrogen  $\text{NO}_3^--\text{N}$ .

Organisms that decompose organic matter use carbon as a source of energy and nitrogen for building cell structure. They need more carbon than nitrogen. If there is too much carbon, decomposition slows once the nitrogen is used up causing some decomposers to die. Other organisms form new cells using their stored nitrogen resulting in more carbon being burned. Thus the amount of carbon is reduced while nitrogen is recycled. Decomposition takes longer, however, when the initial C:N ratio is much above 30.

We use C:N ratios to determine the necessary pile inputs. Each addition of new material should have an initial C:N between 25:1 and 35:1. This ratio can be calculated by hand with a list of common inputs, their volume, and their C:N. It is much easier to use a compost calculator (see below). As the pile matures, the C:N will change, with the ideal finished compost C:N ratio below 21:1.

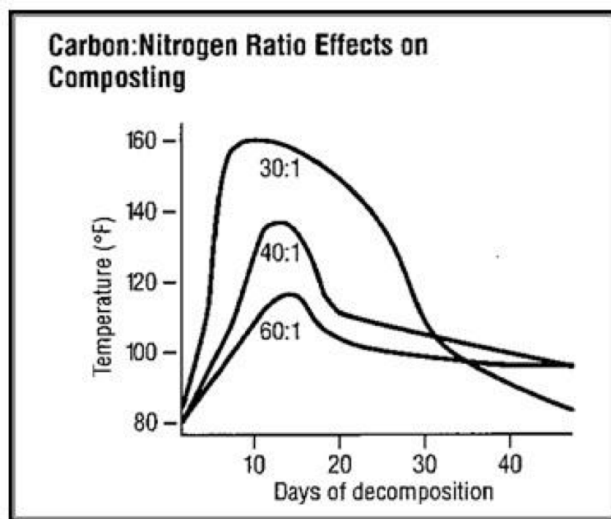


Figure 1 C:N and the Temperature /Time relationship. Image credit: Washington State University

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## PILE MOISTURE

Water is necessary for the pile to break down efficiently. Pile moisture helps microbes move through the pile and is useful for maintaining steady pile temperatures. Using the Squeeze Test below, pile moisture should be recorded on the data sheet, using a scale of 1 (low moisture) to 3 (too much moisture).

An easy way to test for adequate pile moisture while in the HH is the “Squeeze Test.” Pick up a handful of compost, from anywhere in the pile, and squeeze it. The material should stick together, but water (leachate) should not squeeze out (record a 2 on the data sheet). If the pile is too dry, the material will not hold together and water should be added (record a 1 on the data sheet). If the pile is too wet and water is squeezed out, more carbon material should be added (record a 3 on the data sheet). Too much water can cause decomposition to slow down, or can cause the pile to become anaerobic.

## PILE AERATION (ALSO KNOWN AS “TURNING”)

The active flow of air through the pile is important to keep the decomposing without unpleasant smells (Alexander, 2007). Turning the pile creates new passages for microbes to move through, making composting more efficient. Aeration can be accomplished with several methods, but turning the pile with shovels is the most common. Piles should be turned only after they have reached  $>155^{\circ}\text{F}$  for 3 days. This time/temperature relationship ensures pathogen and weed seed reduction. It is still important to wear a facemask and necessary protective gear when turning a pile, even though the process to remove pathogens and weeds has taken place.

To turn the pile, simply put a tarp on the ground in front of the pile and shovel all the material out, onto the tarp. This causes the pile to lose some moisture, often in the form of steam, which can be a helpful way of reducing pile moisture. Once all the material is out of the bin, the material should be shoveled back into place, taking care to mix up the material. Mark the day of the piling turn on the data sheet (See pages 48 and 49 in the Appendix for data sheets).

## BULKING AGENTS

Bulking agents are larger pieces of material that increase the free air space within a pile. The most available bulking agents within the HH are woodchips. Woodchips can help create valuable paths for air and moisture flow, and add carbon to the pile.

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# Pile Temperature

This section focuses on the importance of pile temperature and the procedure for taking turned, aerobic compost pile temperatures (other types of piles will require slightly different methods). Heat from compost piles is produced as a by-product of microbes breaking down organic material. The heat production depends on pile size, moisture content, aeration, C:N ratio, and the ambient air temperature.

## TEMPERATURE CURVES

The ideal internal temperature of a compost pile changes as the pile matures. Young piles will start with cooler temperatures and then begin to warm up as the waste begins to break down.

In order to kill weed seeds and pathogens, piles must maintain temperatures over 155°F, for 3+ days (see TMECC manual for more information on the time/temperature relationship for pathogen reduction).

Eventually, after significant degradation of the readily available organic matter, pile temperatures decrease. Since few thermophilic organisms actively carry on decomposition above 160°F, it is undesirable and potentially dangerous to have temperatures above 160°F for extended periods.

Compost can ignite at temperatures over 160°F.

The compost enters a curing stage, during which mesophilic microbes (actinomycetes, bacteria, and fungi) begin the slower rate decomposition of the less readily available energy sources (hemicellulose, cellulose, lignocellulose and lignin).

Temperature	Predominate Bacteria	Affect
50–104°F	Mesophilic	Slower decomposition, indicating young pile or curing pile
105–160°F	Thermophilic	150–160°F When maintained for three days, kills pathogens and seeds
>161°F	Extremophiles	Potential for fire, most bacteria and fungi killed

**Table 1** Temperature relationship with bacteria

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## HOW TO TAKE PILE TEMPERATURES

Pile temperature gives the compost monitor a good idea of what is happening in the pile and what, if any, steps should be taken. Four separate positions should be tested within each pile to give a complete picture of the processes happening within each pile. (See pages 48 and 49 in the Appendix for data sheets.)

**Step 1:** Record the ambient air temperature. This should be taken away from the piles, in a generalized area that applies to all of the piles. Use the temperature probe for the ambient air temperature reading, so that all temperature readings reflect the same (if any) temperature calibration.

**Step 2:** Place the probe about 5 inches into the pile at its topmost peak. This represents where the heat from the center moves up and out of the pile. This is position #1.

**Step 3:** Push the probe into the center of the pile. The probe will be almost entirely in the pile if the pile is at least 3x3x3 feet. This is position #2 and should represent the highest temperature in the pile.

**Step 4:** Remove the probe and place the tip of it in the left-hand, front corner of the pile. This temperature gives a good indication of the general temperature of the outer edge of the pile. This is position #3.

**Step 5:** Remove the probe and place it in the right-hand, rear corner of the pile. This position is a good indicator of how well the contents of the pile are distributed and mixed. This is position #4.

### TIPS:

- Leave the probe in place long enough for the reading to stabilize, and record the temperature.
- If measuring several piles in a row, save time by measuring similar temperatures in consecutive order. Example: Pile 1 Temperature Positions #1, #2, #3, #4; Pile 2 Temperature Positions #4, #3, #2, #1; Pile 3 Temperature Positions #1, #2, #3, #4; Pile 4 Temperature Positions #4, #3, #2, #1.
- Always use the same units when taking any measurement. We currently use °F, feet and inches, and gallons. If you plan to switch to metric, alert everyone, and change this. If a temperature seems inconsistent with previous recordings, reposition the probe. Compost may have hotter and colder pockets depending on the moisture content and chemical composition of ingredients.

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# Compost Testing

Compost testing is a standardized procedure. Sampling of material should be done in accordance with 02.01 FIELD SAMPLING OF COMPOST MATERIALS (see Sampling below). All tests outlined here are should be performed as detailed in the TMECC manual. The TMECC can be downloaded from the US Composting Council site at <http://compostingcouncil.org/tmecc/>. It is important to record the method of testing with the test results.

## pH

04.11 ELECTROMETRIC pH DETERMINATIONS FOR COMPOST

## Soil Organic Material

05.07 ORGANIC MATTER

## Viable Weed Seeds

05.09 VIABLE WEED SEEDS

## Bioassays

05.05 BIOASSAYS

## Bulk Density

03.03 BULK DENSITY

## % Solids / % Moisture

03.09 TOTAL SOLIDS AND MOISTURE

## C:N

05.02-A CARBON TO NITROGEN RATIO

## Air Capacity

03.01 AIR CAPACITY

## NPK and Other Nutrients

04.02 NITROGEN

04.03 PHOSPHORUS

04.04 POTASSIUM

04.05 SECONDARY AND MICRONUTRIENT CONTENT

## PARTICLE SIZE (COMPOST SCREENING)

Preliminary results suggest this will be the most limiting test of compost produced in the HH. There largest particle size for any end use is <1.0", so a ¾" or 1" screen is necessary. We are still researching the best method for screening. Growing Power uses a bicycle powered drum. In the past, our material has been hand screened onto tarps, but this process is messy and labor intensive.

Regardless of the method, the larger material that is left behind should be saved. It is an excellent inoculant for new compost piles.

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## COMPOST SAMPLING

The following is taken directly from 02.01 FIELD SAMPLING OF COMPOST MATERIALS of the TMECC manual. Additional notes are made in italics. It is highly recommended that before sampling is done, the compost manager read the entire section on Sampling from the TMECC manual.

8.2 For most feedstock or compost samples, use containers made of stainless steel, plastic, glass or Teflon. These materials will not change compost chemical quality. Laboratories provide advice on appropriate sample containers, preservatives and shipping instructions when requested. The type of container used, provided the container is clean and sealable, does not affect most testing procedures. However, glass is the least reactive appropriate to all tests. Care should be taken to not break the glass.

8.3 A representative compost sample must be collected from appropriate sampling locations and consist of no less than 15 point-samples. Sampling locations along the perimeter of the compost pile where compost point-samples will be extracted and vertical distances from the ground or composting pad surface shall be determined at random, and shall be representative of the compost on the site. It is important to not introduce bias into the sampling process. Please review Chapter 2 of the TMECC manual for complete details and instructions.

## Compost Uses

Depending on the results of compost testing, finished compost can have a variety of uses. The compost produced in the HH will likely be limited by particle size, if wood chips were used as a carbon input during the composting process.

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## END USE PARAMETERS

**Table 2** End use parameters of compost

Parameter	Growing Media	Turf	Planting for Beds	Vegetable Crop	Blended Topsoil	Landscape Mulch
pH	5.5–8.0	5.5–8.0	5.5–8.0	5.5–8.0	5.5–8.0	5.5–8.0
% Moisture	35–55%	35–55%	35–55%	35–55%	35–55%	35–55%
SOM	30–65%	30–65%	30–65%	30–65%	30–65%	>30%
Maturity (based on Bioassay)	Must Pass	Must pass	Must Pass	Must Pass	Must Pass	Must Pass
Viable Weeds	none	none	none	none	none	none
C:N	<20:1	<20:1	<20:1	<20:1	<20:1	<20:1
Particle Size (Screen Size)	½ " screen size	1" screen size	1" screen size	1" screen size	1" screen size	1" screen size

## RAISED BEDS

Raised bed soil recipes are similar to potting mixes. If the raised bed does not have contact with the soil below it (which is necessary if the soil is contaminated or potentially contaminated), the recipes are essentially the same. If the bed does not have a barrier between the bed mix and the soil below, the recipe can use less vermiculite, as drainage will not be as big of an issue. If there is no barrier between the soil and the bed, there is no need for worm castings, as worms will likely join your garden naturally. If there is a barrier, the addition of worm castings can help increase nutrients.

- 1–2 parts sifted compost (<1" screen)
- 1 part vermiculite or clay
- 1 part coconut coir
- ½ part worm castings (optional)

## POTTING MIX

Potting mixes are used in container gardens, including in the hanging gutters of the HH. These mixes emphasize good drainage and lightweight, which is especially important for the gutters. A finer sifted material is called for here, because space and weight are at a premium and large pieces of wood serve little purpose.

- 1 part sifted compost (<0.5" screen)
- 1 part vermiculite
- 1 part coconut coir
- ½ part worm castings

## SOIL AMENDMENTS

As a general soil amendment for existing plants (turf, existing garden beds, existing potted plants including house plants), compost can be applied without adding additional materials. It is best to use compost screened to <1" for general soil amending.

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# Troubleshooting

The most common problems when producing compost in a HH are odors, weed seeds, low pile temperatures, and pests. Low pile temperatures do not kill weed seeds, and are thus covered in the same section.

## ODORS

Odors are most likely caused by anaerobic conditions caused by too much moisture or a lack of oxygen flow, or too much nitrogen. Anaerobic conditions lead to odors from volatile organic acids and sulfides. If foul smells are emanating from a specific pile, follow these steps:

1. Make a note of the smells on the data sheet.
2. Calculate the pile's C:N ratio using the recorded inputs and the Klickitat County Compost Calculator. A C:N below 25:1 could be the cause of the odor.
3. Take the pile's temperature in the each of the four positions. An excessively high temperature ( $>160^{\circ}\text{F}$ ) could indicate a pile that has gone anaerobic or has too low C:N ratio. Compare these temperatures to the recent temperatures taken. Has the pile had several consecutive days of high temperatures? This could indicate anaerobic conditions, rather than low C:N.
4. Check the pile's moisture content using the Squeeze Test, outlined in the Pile Moisture section. If the pile scores a 3 and has for several days or has had more wet material (coffee grounds, lettuces, tomatoes, wet leaves) than usual recently added, the pile may be anaerobic.
5. Review the previous inputs. Materials like wet leaves, hay, and cardboard can cause mats to form that prevent the flow of oxygen, leading to anaerobic conditions.
6. Determine the cause (anaerobic or a low C:N) based on steps 2–5. Learn from this lesson.
7. Turn the pile and add bulking agents to increase air flow and raise the C:N ratio.

## LOW PILE TEMPERATURES

Low pile temperatures can create ideal environments for the proliferation of weed seeds and pathogens. Internal pile temperatures must reach  $>155^{\circ}$  for at least three days in order to kill seeds and eliminate pathogens. Each pile must reach this temperature twice, so that all material from the outside of the pile has had the opportunity to be on the inside (another reason piles are turned). If temperatures are not increasing as expected, follow steps 2, 3, 4, and 5 listed above. It is likely that the pile needs to be turned to increase air flow, is too small to maintain high enough temperatures (add more material using compost calculator for C:N, with a less carbon than normal  $\sim 20:1$ ), or the pile needs more moisture. Remember to add water last, as turning a freshly watered pile is very hard work.

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## INERT MATERIAL

Inert material is inorganic material that does not belong in the compost pile. In the case of the HH, inert material is most likely going to be plastic gloves used in the kitchen. HH staff and volunteers should be wearing abrasion/cut resistant gloves when handling the feedstocks, so it is a simple task to remove the inert material before it enters the pile. Inert material does not break down like the organic material that composes the rest of the pile, and can pose problems later on in the composting process. Other types of inert material may include stickers left on produce, rubber bands, or cutlery. Again, safety is important when handling feedstocks, so be aware sharp material may be found.

If inert material is routinely found in the waste material, contact the appropriate kitchen supervisor, and explain the problem. Compost managers may need to do additional training with the kitchen staff to ensure inert materials are not added to the diverted material.

## WHITE, ASHY LOOKING MATERIAL WITHIN PILE

This is not ash, although it certainly looks like ash. It is actually actinobacteria. These bacteria are easily recognized as a powdery or ashy white growth that can show up in a compost pile with reduced oxygen (Mitchel, 2012). The presence of actinobacteria, an anaerobic bacterium, indicates a lack of oxygen. It is caused from a lack of airflow or insufficient carbon inputs. Follow steps 1–6 above to correct this problem.

## Considering a Location for Compost Piles

In choosing a location on campus for piles, consider:

- Management operations: access to roads and ease of handling materials.
- Water quality protection: siting is the first step in preventing leaching and run-off into surface or groundwater.
- Access to water to keep piles moist.
- Neighborhood relations: odor, noise, dust, debris and appearance of your operation.

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# Data Sheet Templates

[illegible]

# Data Sheet Templates

[illegible]

# Composting Resources

## BOOKS

The Rodale Book of Composting: Easy Methods for Every Gardener Paperback (January 15, 1992), by Grace Gershuny and Deborah L. Martin

Worm Cafe: Mid-Scale Vermicomposting of Lunchroom Wastes Paperback (October 6, 2003), by Binet Payne and Paul Bourgeois

## COMPOSTING WEBSITES AND ONLINE RESOURCES

- Building 3-Bin Compost System  
<http://www.rodaleorganiclife.com/garden/make-fertilizer-faster-building-ultimate-compost-bin>
- Building a 3-Bin Compost System from Pallets  
<http://www.growingagreenerworld.com/building-pallet-compost-bin/>
- Cornell Waste Management Institute, Cornell University  
<http://compost.css.cornell.edu/>
- Do the Rot Thing: A Teacher's Guide to Compost Activities  
[http://www.cvswmd.org/uploads/6/1/2/6/6126179/do\\_the\\_rot\\_thing\\_cvswmd1.pdf](http://www.cvswmd.org/uploads/6/1/2/6/6126179/do_the_rot_thing_cvswmd1.pdf)
- EPA: Types of Composting and Understanding the Process  
<http://www.epa.gov/sustainable-management-food/types-composting-and-understanding-process>
- Food Waste Composting In School Cafeterias  
<http://www.charlestoncounty.org/departments/environmental-management/school-cafeterias.php>
- Life Lab: The Ultimate School Composting Resource Page  
<http://www.lifelab.org/composting/>
- The Test Method for the Examination of Composting and Compost (TMECC)  
<http://compostingcouncil.org/tmecc/>
- UW Extension Master Composter Program Resource Guide  
<http://www4.uwm.edu/shwec/publications/cabinet/composting/Master%20Composter%20Resource%20Guide.pdf>
- Wisconsin Department of Natural Resources: Classroom Composting  
<http://dnr.wi.gov/org/caer/ce/eeek/teacher/pdf/recycle/ClassroomCompost.pdf>

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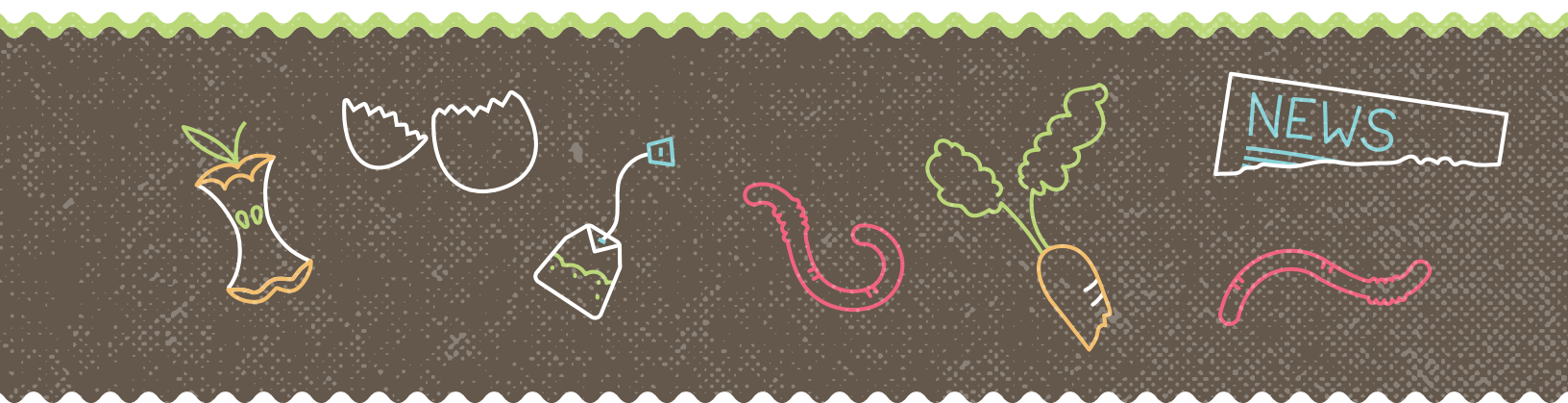
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